# CEMENT AND LIME MANUFACTURE

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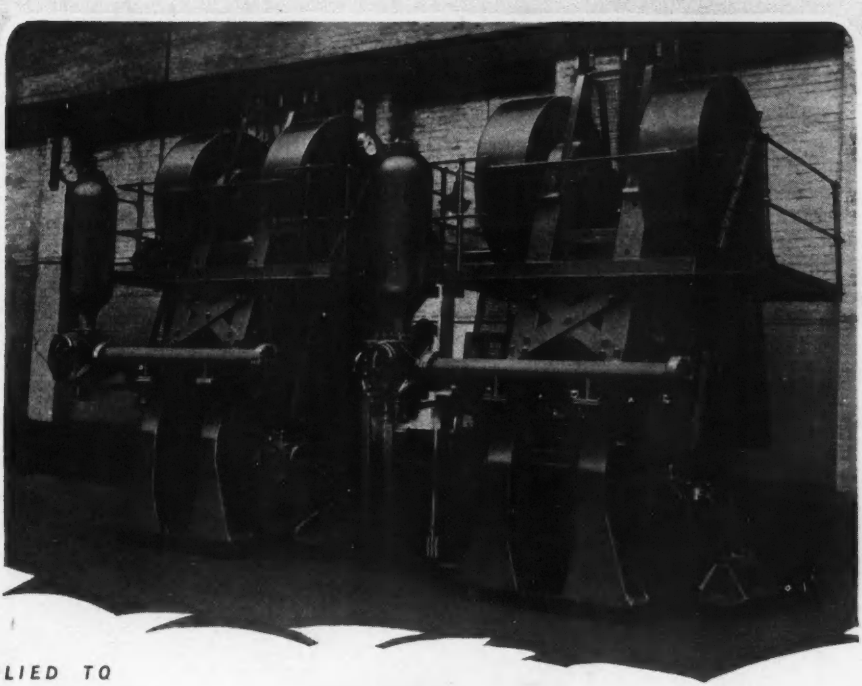

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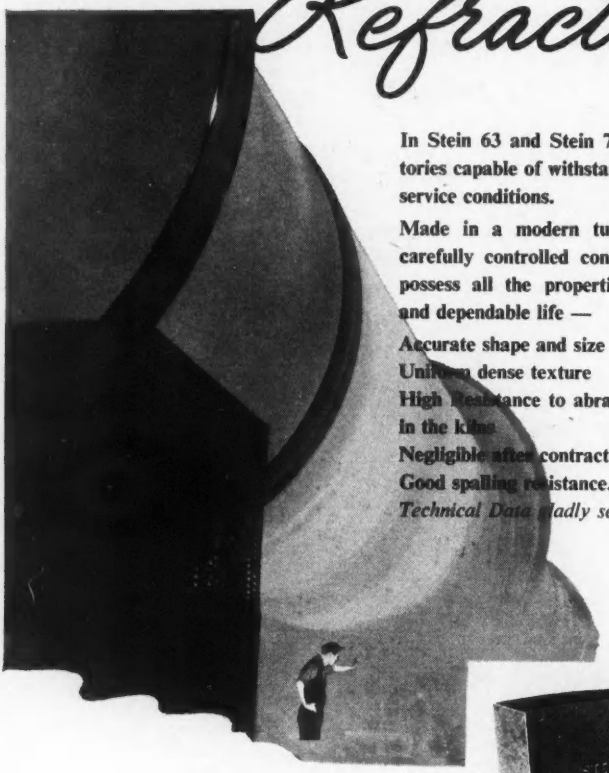

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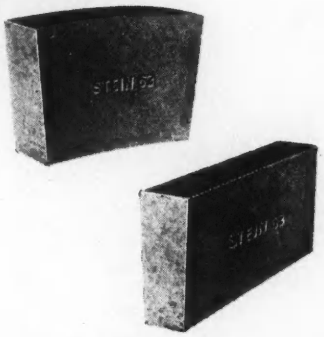


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VOLUME XXIV. NUMBER 5. SEPTEMBER, 1951

## New Cement Works at Shoreham.

### CAPACITY 350,000 TONS A YEAR.

THE new works (*Fig.* 1) of the British Portland Cement Manufacturers, Ltd., near Shoreham, Sussex, started production early this year, and is now in full operation. The works cost about £2,500,000, and has taken four years to build. It is one of the most up-to-date in the world, and care has been taken in its architectural design to ensure that it is not unsightly. The arrangement of the plant provides easy operation, economy in labour, ease of overhaul, and cleanliness. Cleanliness has not always been a feature of cement works in the past, but at this works much care has been taken in this respect. About £130,000 has been spent on dust-collecting equipment, and the plant is almost free of dust. Elevations of the works as designed are given in *Fig.* 2 and a plan in *Fig.* 3 (pages 78 and 79).

The main works is built on both sides of a public road, the production section being in an old quarry used during the past fifty years for supplying raw material to the old cement works. The packing plant, offices, rail sidings, and coal unloading plant are on the site of the old works on the other side of the road and between the road and the river Adur. The two parts of the works are connected by a bridge (*Fig.* 4) carrying the cement and coal conveyors. The main span of the bridge is about 130 ft., this span being necessary to allow for future widening of the road. A tunnel under the road provides road and rail connection between the two parts.

As the main part of the works is in a quarry, it is screened from view on three sides except for the chimney ; the side that can be seen from the road is shown in *Fig.* 4. In the quarry the works is on solid chalk with a safe bearing pressure of 6 tons per square foot, but on the other side of the road the chalk dips rapidly and in some places it was necessary to drive piles 15 to 73 ft. long through alluvial silt to chalk.

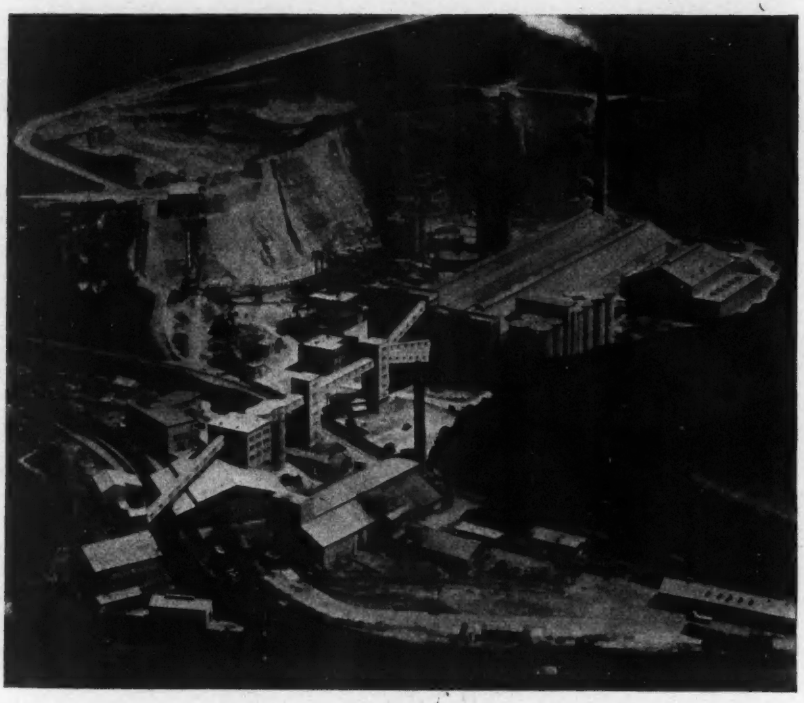


**Fig. 1.—New Cement Works at Shoreham.**

The works, which has an output of 350,000 tons of cement a year, comprises essentially three separate sections, namely (1) A clay plant at Horton, about 2½ miles distant from the works, at which the clay is dug, made into slurry, and pumped to the works ; (2) The chalk quarry, which is at present adjacent to and well above the main works level ; and (3) The main works.

## Clay Plant.

The clay plant is self-contained for the production of clay slurry, and has its own substation. Power is taken from the grid at 11,000 volts and transformed to 3000 volts and 415 volts for motors, 240 volts for lighting, and 110 volts for portable tools. The clay is dug by a Stothert & Pitt multi-bucket excavator (*Fig.* 5) with a capacity of 70 tons per hour, and delivered to a series of 24-in. band-conveyors. The excavator digs to a depth of 40 to 45 ft. in a dry hole ; it weighs about 70 tons, and is mounted on two 4-wheeled bogies moving on an 8 ft. 6 in. gauge track. The band-conveyors are the ordinary semi-portable surface type, and are moved forward as the cut is extended. The conveyors deliver clay to a 25-ft. diameter Vickers-Armstrongs clay washmill, which is driven by a 200-h.p. motor. The mill has a final drive of crown-wheel and pinion, but in

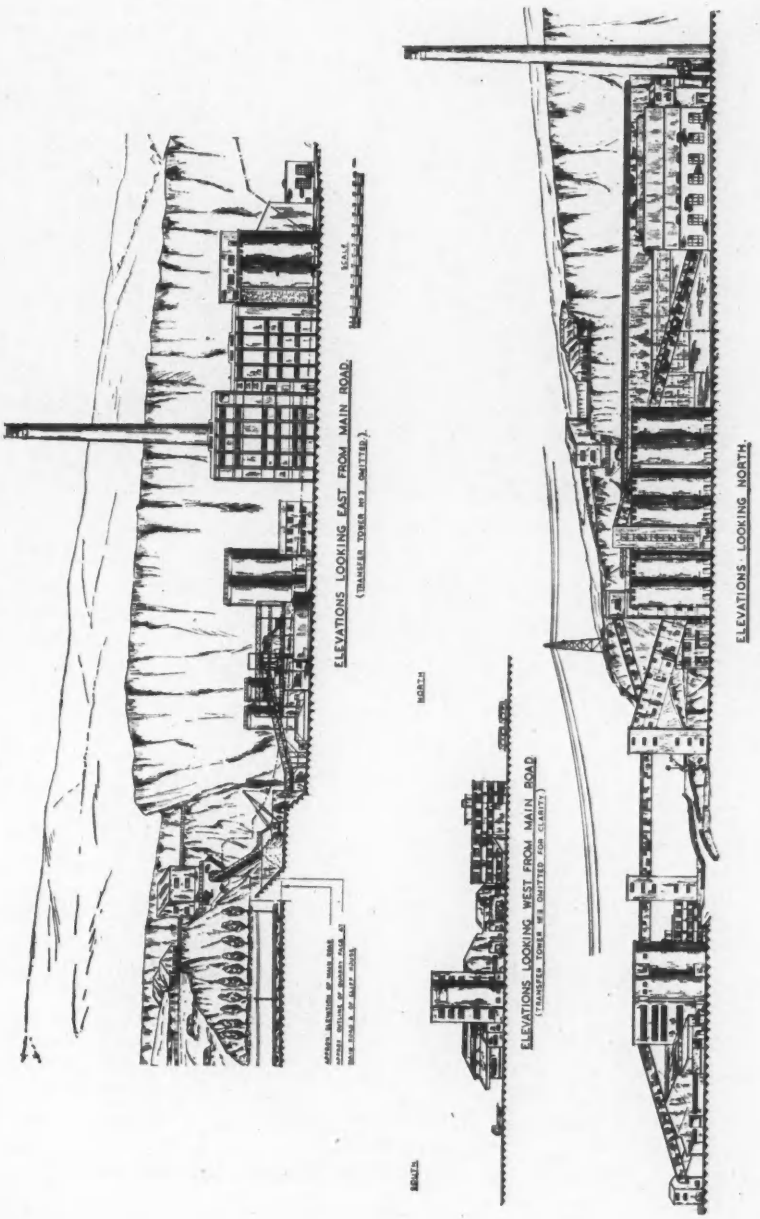

ELEVATIONS LOOKING EAST FROM MAIN ROAD
(TRANSFER TOWER No 3 OMITTED)
ELEVATIONS LOOKING WEST FROM MAIN ROAD
(TRANSFER TOWER No 4 OMITTED FOR CLARITY)
ELEVATIONS LOOKING NORTH

Fig. 2. Elevations.

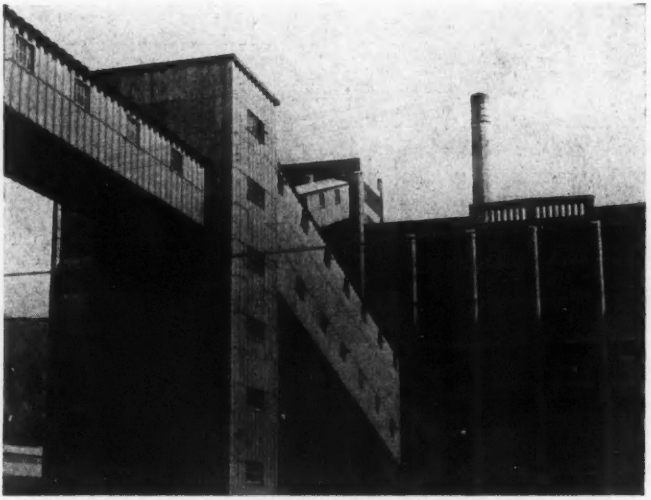


**Fig. 4.—Conveyor Bridge Over Road.**

principle it is similar to the mills at the main works for washing chalk. The clay slurry passes through screens around the washmill, and flows to the storage tank. Stones or other material larger than the screen size are retained in the bottom of the mill, and are removed by opening a door in the floor of the mill and

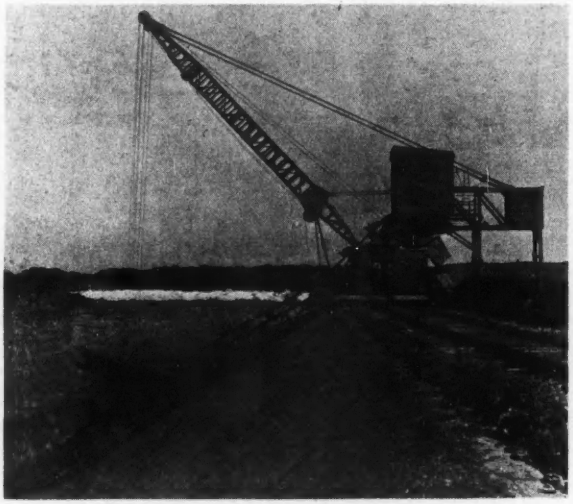


**Fig. 5.—Excavating Clay.**

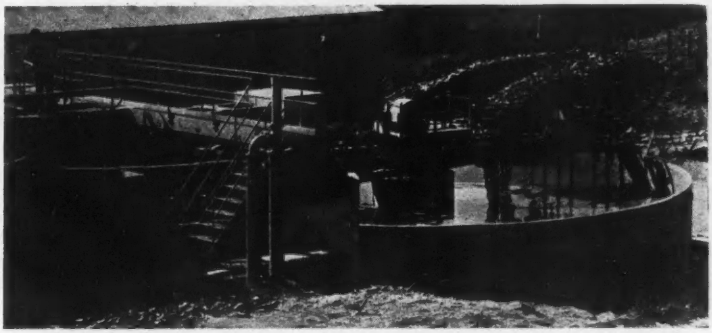


**Fig. 6.—Clay Washmill and Storage Tank.**

allowing the stones to fall into trucks in a tunnel below. The reinforced concrete slurry storage tank is 52 ft. diameter by 10 ft. deep. It has a central " dumpling " on which is a pivoted boom to which stirrers are attached and stir the whole contents of the tank as they rotate. *Fig.* 6 shows the clay washmill and slurry storage tank, with the pumphouse in the background.

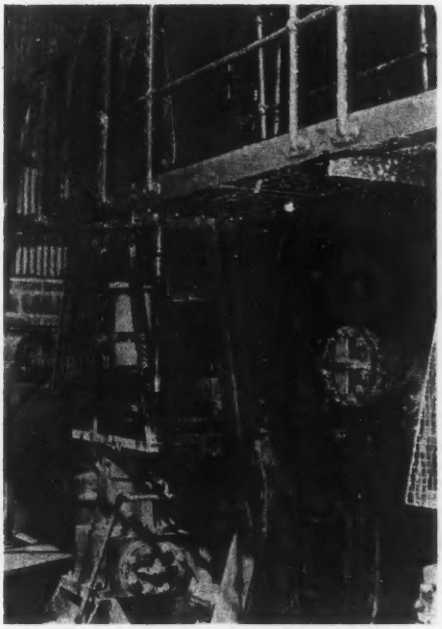


**Fig. 7.—A Slurry Pump.**

From the storage tank the clay slurry passes to high-pressure three-throw pumps supplied by Messrs. Ernest Newell & Co., Ltd., and then through 2½ miles of 8-in. pipeline to the slurry storage tank at the works. The slurry pumps (*Fig.* 7) are designed for dealing with slurries at a working pressure of 300 lb. per square inch. They are of the plunger type, having pistons 10½ in. diameter with 20 in. stroke. They operate at 11½ r.p.m., and are driven by 75-h.p. motors through worm-reduction gears. The 8-in. pipelines are of mild steel ¼ in. thick, with sleeve-welded joints. Two lines are installed to provide a stand-by and also to allow water to be pumped back from the main works when required; the pumping back of water also serves to wash out the pipeline and prevent an excessive accumulation of adhering clay. The pipes were subjected to a test

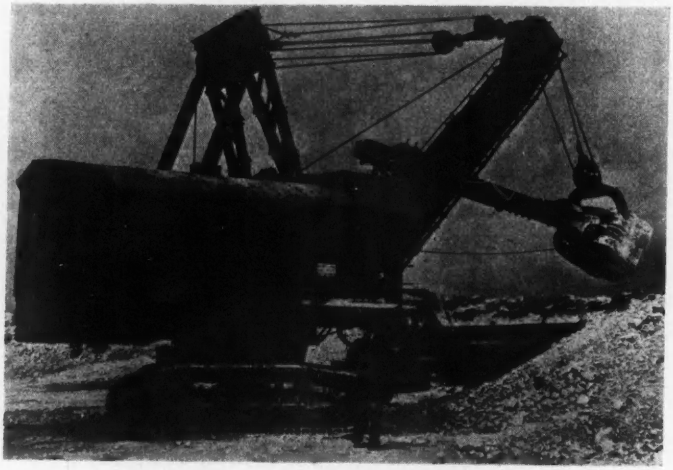


**Fig. 8.—Loading Chalk into Dumper-trucks.**

pressure of 600 lb. per square inch, and are protected against external corrosion by bituminous-asbestos sheeting. The water supply for washing is taken from a lake formed in an old clay pit adjacent to the new workings, and which can be replenished from the main works when necessary.

## Chalk Quarry.

The chalk quarry is at present about 250 ft. above the level of the works. It is intended to work in separate cuts or benches of 30 ft. to 40 ft. over the whole area, so that seven cuts will be made before works level is reached; it is likely to be forty or fifty years before this stage is reached. The chalk is dug by a 3½ cu. yd. Ransome-Rapier shovel (*Fig.* 8), and loaded into 9 cu. yd. Aveling-Barford dumpers, which carry the chalk to the crusher house. As the working is now in top chalk, which is relatively soft, the shovel is able to dig without assistance, but in lower cuts blasting may be necessary.

The crusher is at about 120 ft. above works level. This arrangement gives fairly easy down grades of working roads from the quarry face, and will be

satisfactory for 15 to 20 years when it will be necessary to lower the crusher or to provide a new one at a lower level. The crusher (by Messrs. Edgar Allen & Co., Ltd.) is of the Kibling roll type, having a capacity of 300 tons per hour down to 10 in. cube. It is driven by 100-h.p. motor, with vee-rope drive and spur gearing to 8·44 r.p.m. From the crusher a chute, with chain controls, delivers the chalk to a stockpile of about 2000 tons, or one day's supply, at works level.

## The Main Works.

CLAY SLURRY.—The clay slurry is stored at the works in a reinforced concrete tank 66 ft. diameter and 15 ft. deep, with central dumpling on which a rotating girder is mounted. This girder carries an air compressor, and air pipes extending

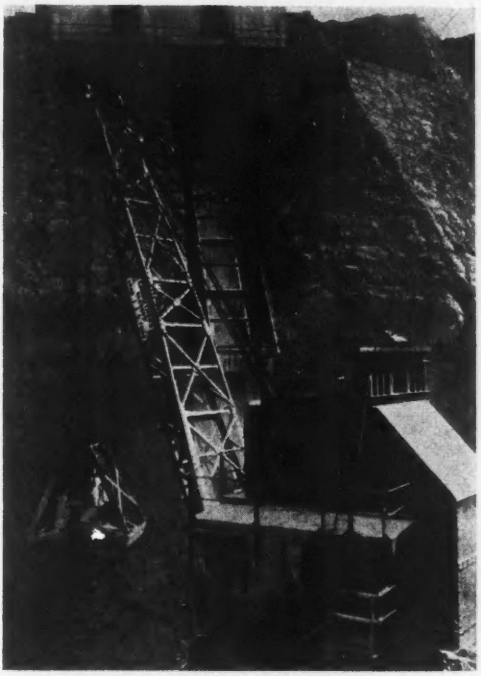


**Fig. 9.—Transferring Crushed Chalk to Conveyor.**

to within 3 in. of the bottom of the tank provide air to agitate the whole contents. From the storage tank the slurry is passed to a breakhead tank which maintains a constant head above two 6-in. Wilfley sand pumps, either of which is used to pump the slurry to a twin-spoon feeder-box which measures the slurry to the chalk washmill. The spoon-feeder is started through a relay system operated by an Adequate weigher mounted on the 30-in. chalk band-conveyor to the washmills. A given weight of chalk passing over the band operates the relay system, and a time-switch stops the feeder after a predetermined period.

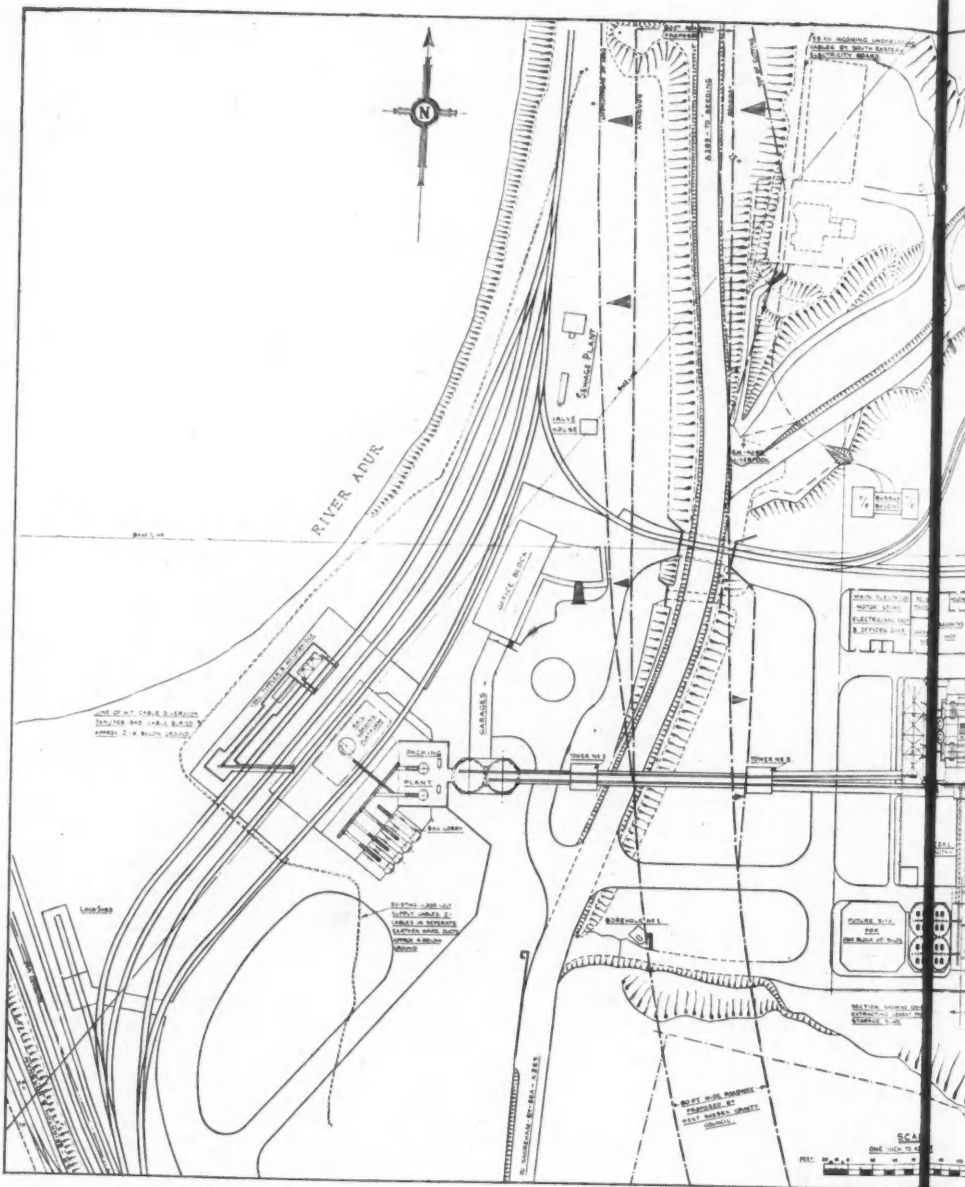
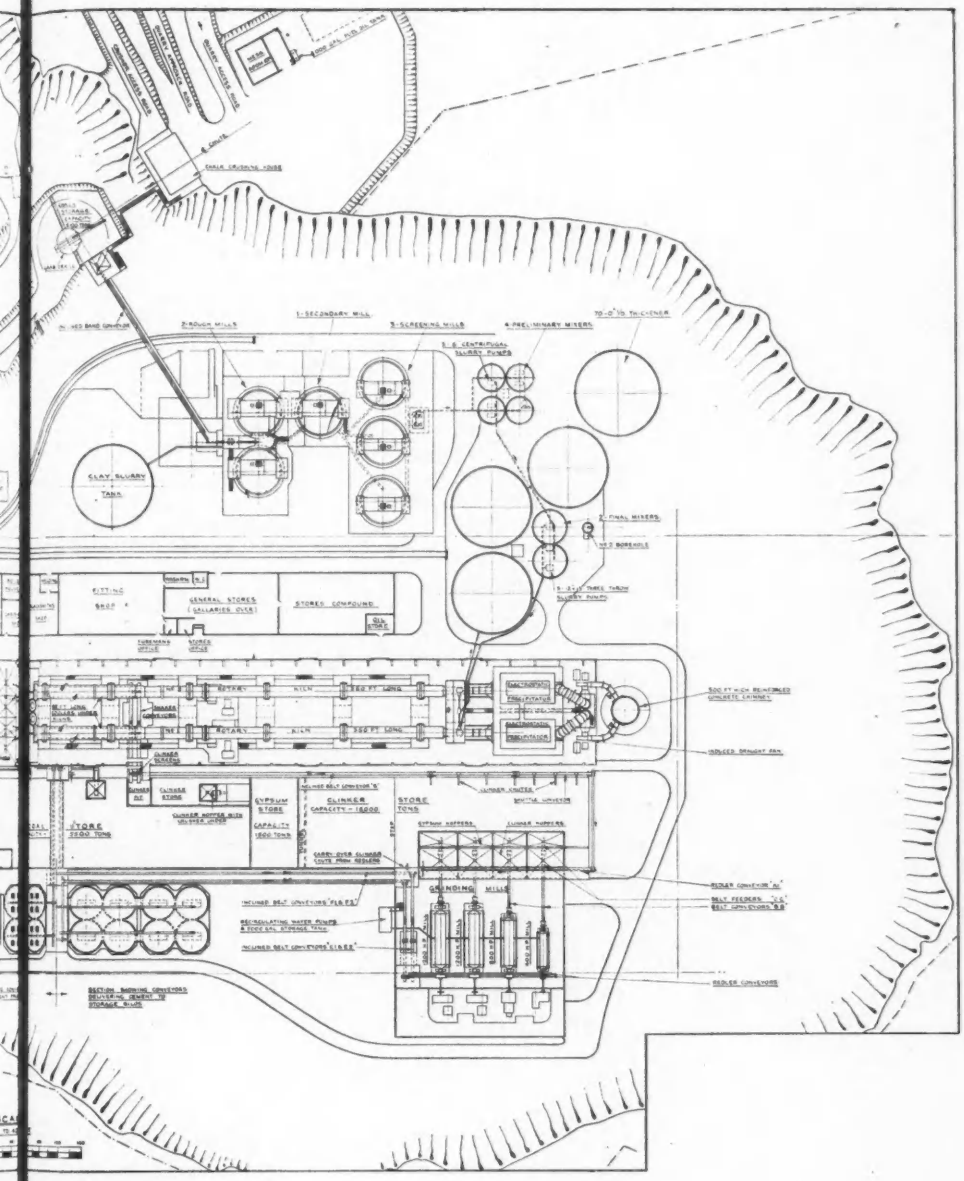



**Fig. 3.—Plan of Cement Works**




**Works at Shoreham.**

CHALK WASHMILLS.—From the pile below the crusher the chalk is lifted by a 11½-tons Carruthers electric grabbing crane (*Fig.* 9) and put on vibrating feeders which deliver it to 30-in. band-conveyors feeding the chalk washmills.

There are two rough washmills for chalk, one secondary washmill and three screening washmills. *Fig.* 10 is a view of the washing plant taken from the top of the final mixers. The mills are arranged at different levels so that there is gravity flow between the various stages. The rough mills are reinforced concrete tanks, 35 ft. diameter, in which revolving arms carrying harrows break down the chalk. The floors of the mills are lined with granite setts, and the walls are protected by short lengths of bullhead rails laid as bricks, in courses, keyed and bonded. Around the periphery of the rough mills the slurry passes through vertical grids with 1-in. and ¾-in. gaps, and thence along troughs to the secondary mill. This mill is similar in design to the rough mills, but has 4-mm. by 1½-mm. mesh sieves around its periphery. Slurry passing through these sieves is carried by troughs to the screening mills, which are the same diameter but lighter than the rough mills with splasher-plates instead of harrows mounted on the rotating arms. In these mills 32-mesh woven-wire screens are arranged around the periphery. The greater part of the breaking down of the chalk is done in the rough and secondary mills; the screening mills do some breaking down but their purpose is to screen the slurry to the required fineness.

All these mills, which are of very strong construction, were supplied by Messrs. Head, Wrightson & Co., Ltd. The drive comprises a motor and totally enclosed reduction gear mounted on a steel bridge over the mill, with a final drive of spur-wheel and pinion. The drives were supplied by Messrs. David Brown & Co., Ltd. The rough mills and the secondary mill are driven by 350-h.p. motors, and the screening mills by 100-h.p. motors. In all cases the speed of the mills is 10 r.p.m. The drive is mounted on a separate bridge to insulate it from vibration.

REMOVAL OF FLINTS.—The chalk contains about 5 per cent. of flint varying in size from 6-in. ring to fine sand, which is removed during the washing process. From the rough mills the flints are periodically discharged, through a door in the floor, into a concrete hopper under each mill. From these hoppers the flints are conveyed to a rotary washer, 24 ft. long by 4 ft. 6 in. diameter, of the contra-flow type; the flints enter at the low end and are discharged at the high end, and the wash-water flows in the opposite direction. At the end of the washer a screen plate separates the flints into those over and under 2-in., each size being discharged on to a separate band-conveyor. The larger flints are suitable for use in potteries, and are taken directly to rail wagons or to a stockpile. The under-size material is taken to another storage area. From the secondary mill the smaller flints are discharged continuously through a duct in the floor to an elevator delivering to a rotating screen with ¾-in. diameter holes. The flints larger than ¾-in. are returned to the mill, and the smaller material is washed in a washing-screw before passing to the storage bins. The reason for returning the larger flints to the secondary mill is that they are of considerable help in breaking down the very hard chalk,

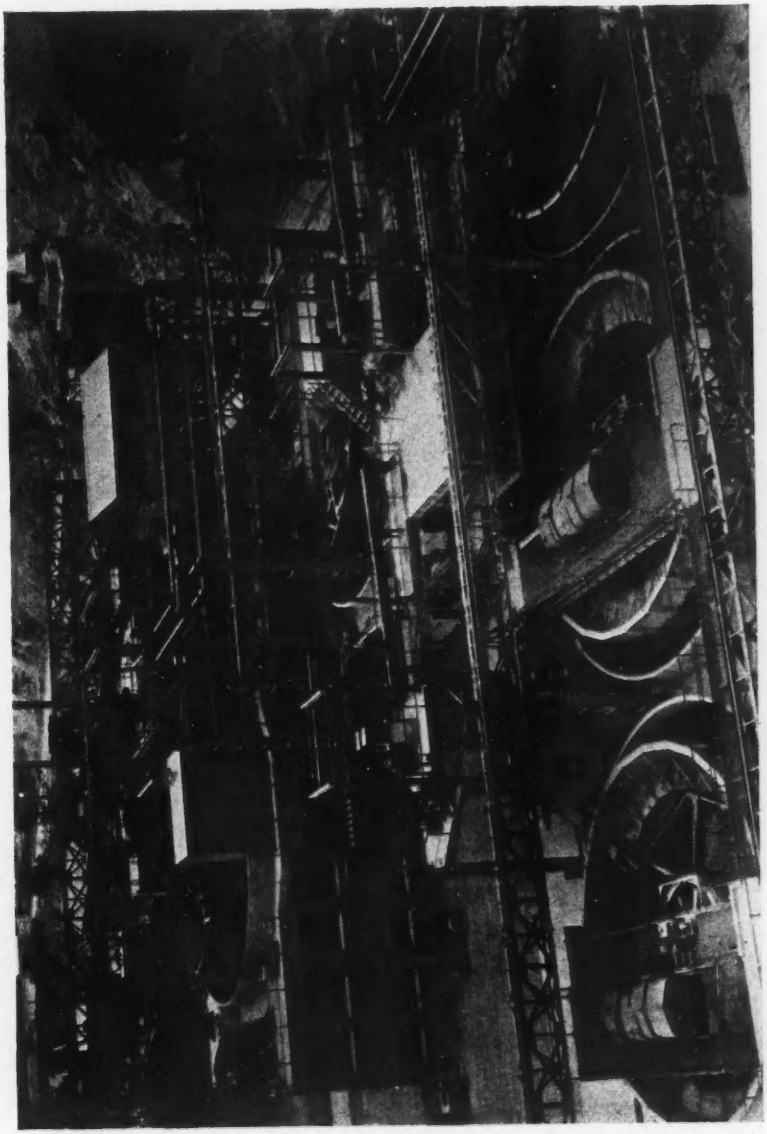


Fig. 10.—View of the Washmills.

that is they act as grinding media. From the screening mills the fine sand passes continuously through ducts in the floors of the mills to small sumps. Here extra water is added, and a 2-in. Wilfley sand-pump delivers the resulting slurry to a Dorr-Oliver bowl-and-rake classifier. This machine extracts all grit larger than 100 mesh. The fine material, which is mainly chalk, is delivered separately as a thin slurry, and is pumped to a Dorr-Oliver thickening tank. The thickened slurry is pumped back into the rough mills, and the clear water from the top of the thickener is re-circulated for use in the washers and the screening-mill sandpits. This plant may seem to be rather complicated and expensive, but it produces clean flint which is a saleable material with a minimum of waste and sand residue, and all usable material is kept in the production circuit. Without this plant it

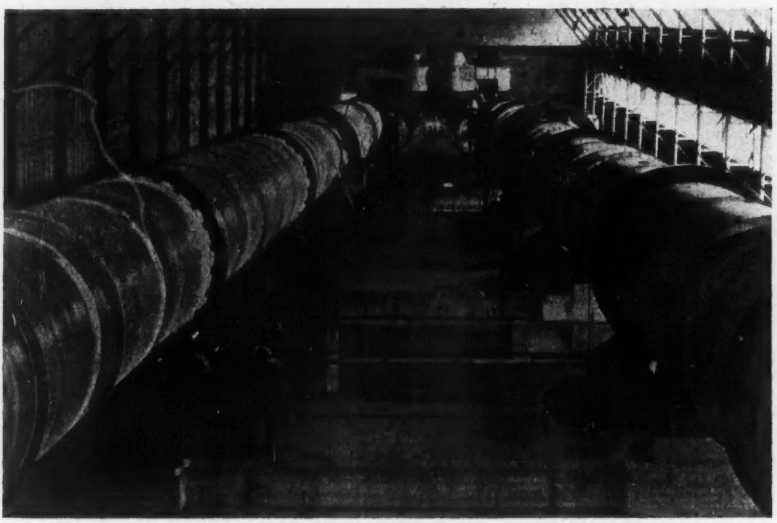


**Fig. 11.—The Kilns, Looking towards Firing End.**

would be difficult and costly to dispose of the sludge from the flint and grit washing plant, and it is possible to wash down the whole area of the washmill plant without the risk of blocking the storm-water drains.

MIXING TANKS.—From the screening mill the slurry is pumped by one of two 6-in. Wilfley sand-pumps to any one of four reinforced concrete preliminary mixing tanks about 24 ft. diameter and 55 ft. high with conical bottoms. By taking slurry from any of these tanks it is possible to control the composition of the final slurry with a high degree of accuracy. From the preliminary tanks the slurry is pumped by 8-in. Wilfley pumps to the final mixers, where a final check is made before it is allowed to flow by gravity to the storage tanks. The final mixing tanks are similar in design to the preliminary mixing tanks, but are 27 ft. diameter

and 76 ft. high. Beneath these tanks are the kiln-feed slurry-pumps. In all these tanks the slurry is thoroughly mixed by blowing high-pressure air through a central pipe for a given period into each tank in turn. The sequence valves and timing gear are electrically operated. Pneumatically-operated depth indicators are fitted to each tank to give an accurate and visual indication of the depth of slurry in the tank.

SLURRY STORAGE TANKS.—The three storage tanks for the finished slurry are similar to the clay-slurry storage tank previously described. From these tanks the slurry is pumped to a tank over the kilns. Three Edgar Allen slurry-pumps are provided for this purpose, one being a standby. These pumps are of the three-

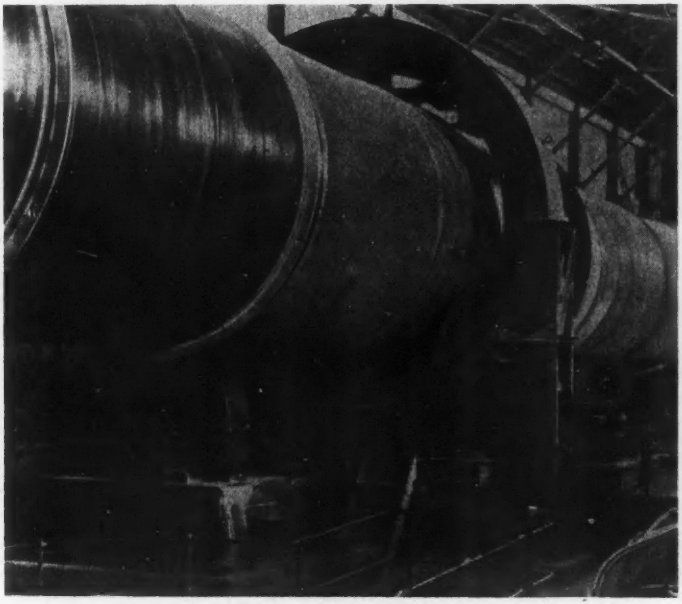


**Fig. 12.—The Kiln Drive.**

throw plunger type, with 12-in. plungers and 15-in. stroke, and have a working pressure of 150 lb. per square inch.

KILNS.—There are two Vickers-Armstrongs kilns (*Fig.* 11), each 350 ft. long by 10 ft. diameter with an enlarged burning zone 11 ft. 6 in. diameter. They slope at 1 in 24, and are carried on six tyres. Each tyre runs on rollers whose spindles are carried in angular-type self-aligning bearings, which are water cooled and fitted with integral oil lifters for distributing the oil over the bearing surfaces. The bearings are carried on cast-iron bedplates, supported on concrete piers. The outward thrust from the rollers is resisted independently of the bedplate by cast-

steel keep castings, held together by tie-bolts passing through the bedplate. The downward thrust of the kilns, due to their slope, is resisted by one fixed thrust-roller and one floating balance-weighted thrust-roller. All the tyre-supporting rollers are exactly parallel, and the downward thrust due to the inclination at the kiln is resisted by these thrust-rollers. There is also a thrust-roller on the upward side of the kiln in order to retain it in its proper position ; this upward movement would only occur under exceptional operating conditions. The total weight of each kiln, with refractory lining and material passing through, is about 1000 tons.

Each kiln is driven by a 150-h.p. variable-speed motor through a vee-rope drive to a reduction gear, and then through further reduction gears fitted in the drive bed of the kiln, and through a girth gear, which is attached to the kiln by tangent plates. The kilns rotate from 0·67 to 1·33 r.p.m. *Fig.* 12 shows the drive on one of the kilns.

The slurry feed is controlled by variable-speed spoon-feeders, and in the back end of the kiln there is a curtain-and-festoon chain heat-transfer system. The clinker is passed to rotary coolers (supplied by Messrs. Ernest Newell & Co., Ltd.), 90 ft. long by 9 ft. diameter arranged under the kilns and supported on two tyres with one fixed-position thrust-roller resisting all down thrust. The coolers slope at 1 in 20. A lifting system is incorporated in the coolers to obtain an equally distributed curtain of falling clinker in order to obtain efficient cooling from the incoming air. The clinker enters the cooler at about 2000 deg. F. and has a temperature of about 220 deg. F. when it is discharged. The coolers rotate at 1½ r.p.m., and are driven by 50-h.p. motors, the drive arrangement being similar to, but smaller than, the kiln drive.

The air passing up the coolers provides secondary air for the combustion of the pulverised coal. The combustion gases and $CO_2$ driven off from the slurry pass through Sturtevant electrostatic precipitators which extract the fine particles from the gas. Each has three electrode chambers, which are arranged so that any one chamber can be shut down for cleaning and maintenance while the other two are in operation, this arrangement being made to ensure that the precipitators operate during the full kiln working time, as it is not necessary to wait for a kiln shut-down before the precipitators are overhauled. The gases are drawn through the precipitators by 100-in. Keith Blackman induced-draught fans (one to each kiln) which discharge into a common chimney 300 ft. high. The chimney is of reinforced concrete, and tapers from 23 ft. 1 in. diameter and 9 in. thick at the base to 13 ft. diameter and 5 in. thick at the top. It is lined throughout with 4½ in. of brickwork, with a 4-in. air-space between the concrete and the lining. The top 15 ft. is built entirely of brickwork, because experience has shown that kiln gases damage the top of reinforced concrete chimneys fairly rapidly while brickwork is not affected so badly, and it is much easier to renew brickwork if this should be necessary.

The kilns are fired with pulverised coal, which is ground in four Atritor machines supplied by Messrs. Alfred Herbert, Ltd. Each machine is driven by a 150-h.p. motor. It is possible to operate each kiln at a reduced rate on the output from

one machine so that it is not necessary to stop the kiln if one of the Atritors needs attention. The hot air for drying coal in the Atritors is drawn from the kiln-hoods through cyclones, which remove any clinker dust in the air stream The Atritors are under the floor at the firing end of the kiln.

The kiln control and indicator panel, supplied by Contactor Switchgear, Ltd., is shown in *Fig.* 13. All plant connected with the kilns, coolers and coal mills

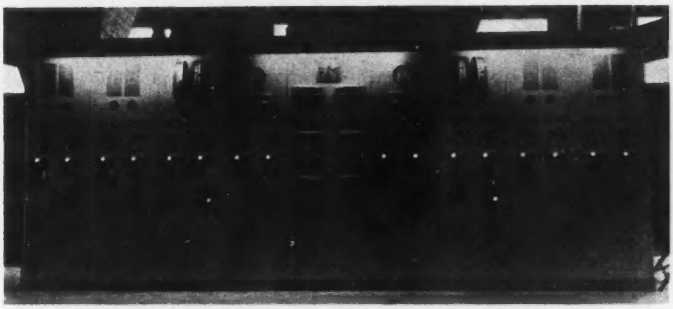


**Fig. 13.—Kiln Control and Indicator Panel.**

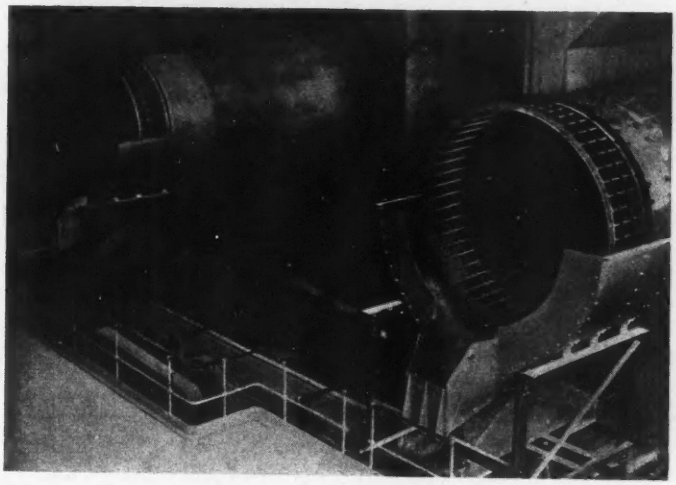


**Fig. 14.—Clinker Discharging from Coolers on to Shaker-conveyors.**

is controlled from this panel ; on it also are temperature indicators and recorders, draught indicators, slurry-feed indicators, and all other controls and information required by the burner. Above the firing floor are the coal-storage hoppers for the Atritors. These are of reinforced concrete and provide storage for about 700 tons of coal ; they are seen in the background of *Fig.* 11. Above these hoppers

are the coal conveyors and the coal crushing and screening plant. Also over these hoppers there are the main water-storage tanks with a capacity of 55,000 gallons.

TRANSPORT OF CLINKER.—From the coolers the clinker is discharged on to either one of two 32-in. Edgar Allen shaker-conveyors (*Fig.* 14). There is a 6 in. mesh grid on the end of each cooler which discharges the oversize clinker to a hopper-bottomed chute, from which it is periodically removed as necessary and taken to the clinker crusher pit. The clinker passing through the cooler grids is carried along the shaker-conveyors, which near the discharge end are double-decked The upper deck, acting as a screen, separates the material larger than 1¼in. and passes it to the crusher pit. The material smaller than 1¼ in. is passed to a 24-in. band-conveyor; if the band-conveyor is under repair all the clinker from the coolers can be taken to the pit in the clinker store.

The band-conveyor system is arranged so that the small clinker can be discharged into the main clinker store or conveyed directly into any one of the grind-

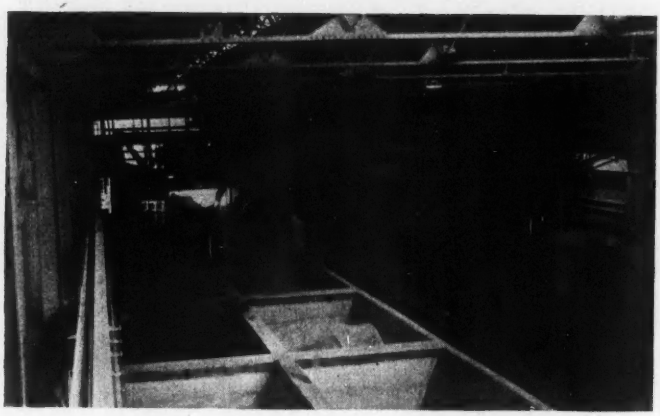


**Fig. 15.—Clinker, Gypsum and Coal Store.**

ing mill hoppers. The oversize clinker is taken by the store crane to a reinforced concrete hopper, from which it is fed to an Edgar Allen swing-jaw granulator by a Ross chain. The crushed clinker falls into another pit, from which it is taken by the crane to the main clinker store. This arrangement for dealing with oversize clinker has the advantage that it is not moved by a band-conveyor at any stage; the large pieces of clinker retain their heat for a considerable time, and can cause considerable damage to the rubber bands.

STORE BUILDING.—The main store building (*Fig.* 15) is 500 ft. long, 75 ft. wide, and from 59 ft. to 62 ft. to the eaves, and provides storage for 15,000 tons of clinker, 1500 tons of gypsum and 5500 tons of coal. These materials are stored in depths of 40 ft., 18 ft., and 16 ft. respectively. The retaining walls are of rein-

forced concrete, and are formed as cantilever buttresses with walls spanning between them. The roof and crane track are carried on steel stanchions, and there is a clear space between the buttresses of the retaining walls and the steel stanchions in order to avoid deflection of the walls causing distortion of the crane track. Two 10-tons Stothert & Pitt overhead travelling cranes are installed. The store building is parallel to the kiln building, with an annexe about 10 ft. wide between the two buildings. In this annexe are all the distributing conveyors for coal, gypsum, and clinker. The cement conveyors to the packing plant are also in this annexe, together with several Visco dust plants at the transfer points on the various conveyors. At one end of the store building there are four elevated reinforced concrete clinker hoppers each with a capacity of 260 tons, and four 100-tons gypsum hoppers, from which the clinker and gypsum are fed to the four grinding mills. Below the clinker and gypsum hoppers there are band-

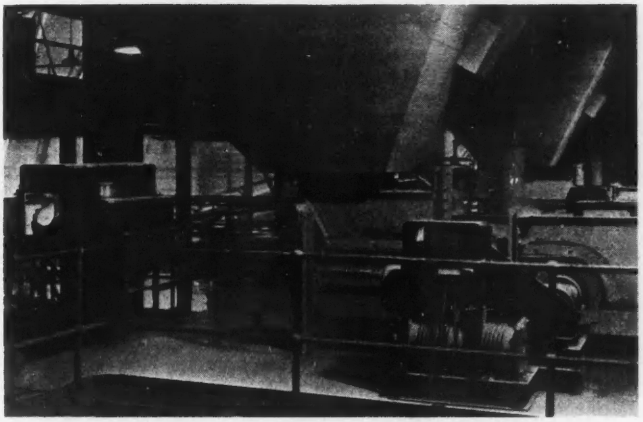


**Fig. 16.—Clinker Feeder and Control Equipment.**

feeders with weighing and constant-feed control gear supplied by Adequate Weighers, Ltd. With this apparatus (*Fig.* 16) the rate of feed to each grinding mill can be controlled.

GRINDING MILLS.—There are four grinding mills, two with 1200-h.p. motors, one 800-h.p., and one 400-h.p. The three large mills are shown on *Fig.* 17 ; the dust-collecting plant is in the background. All the mills are centrally driven at their discharge ends. The motors and gear-boxes are in a separate building. The two 1200-h.p. mills were supplied by Vickers-Armstrongs, Ltd. They are 8 ft. 4½ in. diameter by 45 ft. long, divided into four compartments with chambers of about 30 per cent., 20 per cent., 30 per cent., and 20 per cent. of the length of the mill. The first two chambers are lined with hard alloy-iron plates, and the third and fourth chambers with hard white cast-iron bars. The charge of these mills is about 76 tons, and they rotate at 20·5 r.p.m. The 800-h.p. mill was supplied by Messrs.

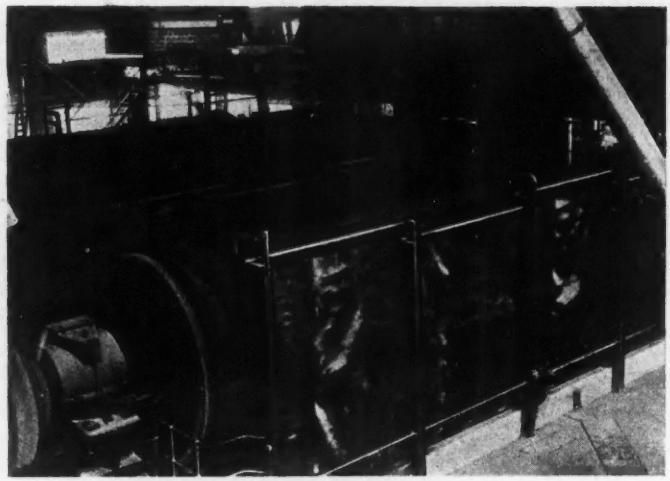


**Fig. 17.—Grinding Mills.**

Ernest Newell & Co., Ltd., and is 7 ft. 6 in. diameter by 40 ft. long. It is divided into three compartments with chambers of about 30 per cent., 40 per cent., and 30 per cent. of the length of the mill. The first two chambers are lined with hard alloy-iron plates and the third chamber with hard white cast-iron bars. The charge of this mill is about 52 tons, and it rotates at a speed of 21 r.p.m. The 400-h.p. mill is 6 ft. diameter by 29 ft. 4 in. long, and was transferred from the old works.

**Fig. 18.—Motors for Grinding Mills.**

It is divided into three compartments, and rotates at a speed of 25 r.p.m. The mill has been re-conditioned, and converted from a peripheral discharge to a trunnion discharge in order to conform to the arrangement of the new works.

The two 1200-h.p. mills are driven by Metropolitan-Vickers motors through totally enclosed double-helical gear-boxes supplied by Turbine Gears, Ltd., and are equipped with barring gears and motors giving very slow rotation to facilitate maintenance work. They have pressure relay switches on the oil supply system which automatically cut out the main-drive motor if the pressure in the oil supply to the gears falls below 15 lb. per square inch. The 800-h.p. mill is driven by a Metropolitan-Vickers motor through a totally enclosed double-helical gear-box

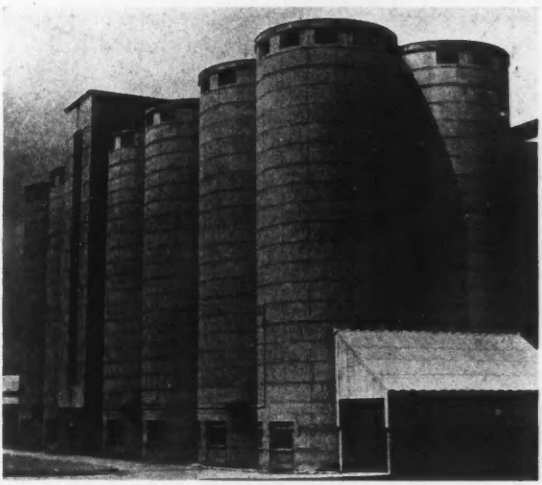


**Fig. 19.—Cement Silos.**

supplied by Messrs. David Brown & Co., Ltd. *Fig.* 18 is a view of the grinding-mill motor house.

DUST COLLECTION.—There are five large Visco dust-collecting plants installed in the grinding-mill house; two deal with the feed and transfer points on the clinker and gypsum conveying system from the hoppers to the inlet end of the grinding mill, and the other three are used for venting the outlet hood of each mill and the cement conveyor system. As there is a good deal of dampness in the air drawn from the outlet end of the mill, these three plants have pre-heated scavenging air equipment in order to keep the filter-stockings clean and dry.

CEMENT STORAGE.—The cement from the mills is discharged into either of two Redler conveyors, which deliver on to 24-in. band-conveyors extending to the top of the main storage silos. At the top of these silos a further series of Redler conveyors is used for distribution. Twelve reinforced concrete storage silos are provided each having a capacity of 1250 tons. They have an inside diameter

of 26 ft. 6 in. and are 80 ft. high. (*Fig.* 19). The silo bottoms are about 10 ft. above ground level; four outlets are provided from each silo to conveyors below. Under the silos there are Redler conveyors which carry the cement through a tunnel under the store building and deliver it to an inclined band-conveyor in the annexe between the kiln and store buildings. Compressed air is used to extract the cement from the silos. Rubber-diaphragm valves are used to control the supply of cement from the silos to the Redler conveyors. A 30-in. inclined band-conveyor in the annexe carries the cement up to the bridge, across the road, and discharges it into either of two 900-tons silos at the packing plant, one of which is

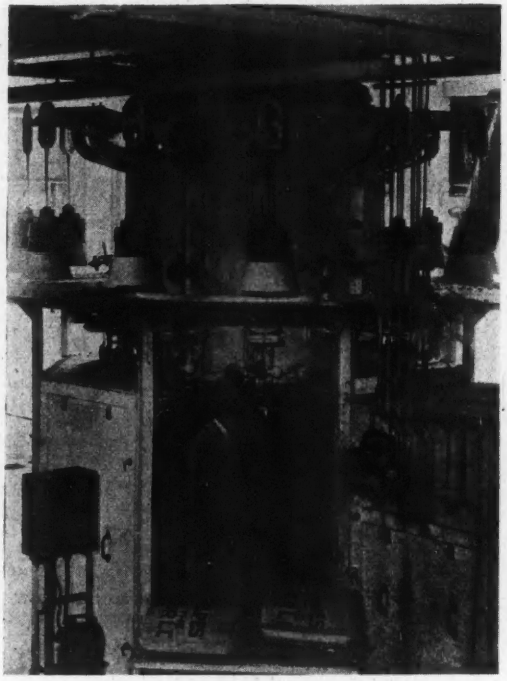


**Fig. 20.—Bag-filling Machine.**

used for ordinary cement and the other for rapid-hardening cement. These silos are similar in design to those for the main storage.

PACKING PLANT.—The cement is drawn from the packing plant silos as required for the packing machines, which are in a five-story building adjacent to the silos. The extraction chutes from the silos have perforated tubes in the bottom through which air is blown to aerate the cement. These chutes discharge into two 24-in. screw conveyors, each feeding a slow-running central discharge elevator with a capacity of 125 tons per hour. The elevators were supplied by Messrs. Ernest

Newell & Co., Ltd., and the silo extraction gear by Messrs. F. L. Smidth & Co., Ltd. Each elevator discharges to a revolving screen in which any foreign matter is removed, and the cement passes to surge hoppers over the Fluxo packing machines. The rate of extraction of cement from the silos is automatically controlled to suit the requirements of the packing machines.

There are two packing machines (*Fig.* 20) of the twelve-spout rotating type, and each is capable of filling 120 tons per hour into 1-cwt. bags. Each machine comprises a central rotating hopper into which the cement is fed from the surge hopper by a pneumatic feeder. By means of stirring and air jets the cement is kept fluid and flows through the twelve spouts in the bottom of the rotating hopper to the bags. The machines are completely automatic except for putting the paper bags on the spouts. The compressed air for cement extraction and packing is supplied by Alley & McLellan compressors. The paper bags are stored on a floor over the loading bays, to which they are elevated from ground level by a slat type elevator, the head of which is shown in *Fig.* 21.

**Fig. 21.—Elevator for Cement Bags.**

From the packing machine the filled bags are carried by band-conveyors to either road or rail loading bays. There are three retractable conveyors (*Fig.* 22) which can be taken out over lorries and deliver the bags to the place where they are to be stacked. For rail loading the bags are delivered to a turntable on a platform between two rail loading tracks; from this turntable they are removed and stacked in wagons by means of sack barrows. The packing and loading machinery are arranged so that the bags from either packing machine can be delivered to either road or rail loading dock. Both by road and rail an average loading rate of 100 tons per hour has been maintained.

RECEIVING COAL AND GYPSUM.—Coal and gypsum are delivered by rail and unloaded by a combined wagon-tippler and weighbridge which discharges on to conveyors passing through the bridge crossing the road, and, in the case of coal, either to the storage hoppers over the coal-grinding plant or to the coal store.

The gypsum follows the same route until it reaches the top of the coal hoppers, where it is transferred to a conveyor running through the annexe and is discharged into the gypsum store. A coal-crushing and screening plant has been installed to deal with coal passing to the store, and no material over ¾ in. is passed to the coal-grinding machines.

GENERAL.—Between the kiln building and the washmills there is a long building 50 ft. wide in which are the substation, carpenters' shop, blacksmiths' shop, fitting shop, and general stores. The building has two stories at the substation end, with electricians' shop and offices on the second floor. The shops are so equipped that nearly all the general maintenance work of the factory can be dealt with.

The water supply is from two boreholes, each delivering 12,000 gallons per hour to the storage tanks and to a 6-in. main around the works. The water used for cooling purposes is recovered and pumped to the clay plant.

**Fig. 22.—Retractable Conveyors for Loading Lorries.**

An office building accommodates the laboratories, office, and canteen. On the ground floor are chemical and physical testing laboratories, first-aid room, men's washrooms, and locker rooms. The first floor is used as offices, and the top floor as dining rooms, kitchen, etc. The main dining hall is arranged so that it can readily be used for social functions.

As the incoming and outgoing goods trains will shortly operate only between midnight and 6 a.m., extensive railway sidings have been installed, two 165-h.p. Ruston Diesel locomotives being provided for shunting.

Generally the buildings are of steel-framed construction, the main exceptions being the office block, packing plant, substation, and one end of the kiln and store building which have reinforced concrete frames. The walls of all buildings are either precast concrete blocks or asbestos-cement sheets. *Fig.* 23 is a view of the packing plant building. Concrete roads have been laid throughout the works, and a storm-water drainage system has been installed to discharge to the river.

The electricity supply is taken from the South Eastern Electricity Board, who have installed duplicate 33-kv. lines, transformed to 3-kv. through two 5000-k.v.a. transformers to the works substation. The substation equipment was

supplied by the British Thomson-Houston Co., Ltd., and the cables throughout the works by W. T. Henley's Telegraph Works Co., Ltd.

Nearly all the motors of 125-h.p. and over are 3000-volt machines ; the smaller motors are 415 volts. The larger motors were mainly supplied by Metropolitan-Vickers, Ltd., and the smaller ones by Crompton Parkinson, Ltd. Except where mentioned otherwise, the reduction gears for the smaller machines were supplied by Stone-Wallwork, Ltd.

Messrs. Oscar Faber & Partners were the consulting engineers for the civil engineering work. Mr. G. A. Jellicoe, F.R.I.B.A., supervised the architecture. The main contractors for the civil engineering works were Messrs. John Laing &

**Fig. 23.—Packing Plant and Road Delivery Dock Loading.**

Co., Ltd. The sub-contractors for the reinforced concrete work were Messrs. Bierrum & Partners, Ltd., and for the structural steelwork Messrs. Redpath, Brown & Co., Ltd. The civil engineering work at the clay plant was done by Messrs. J. L. Kier & Co., Ltd., and the mechanical handling plant at the works by Mitchell Engineering, Ltd.

The arrangement, design and erection of the plant were carried out by the Works Engineering Department of the Associated Portland Cement Manufacturers, Ltd.

## Storing Fuel.

THE Coal Utilisation Council has issued a booklet entitled " Architectural Design Data for Solid Fuel " (price 7*s.* 6*d.*). The text deals with the storage of large quantities of coal, and is more a subject for engineers and factory owners than for architects. A great deal of data is given in handy form on the calorific values of fuels, methods of storing in the open and under cover, the removal of ash, and on methods of handling coal.

### A New French Clinker-slag Cement.

A SUPERIOR clinker-slag cement referred to as CLK. 250-315, is now included in French Specification P15-305 (see page 119 of this journal for November, 1950). The compressive strength at seven days is 3556 lb. and at 28 days 4480 lb. per square inch (250 kg. and 315 kg. per square centimetre).

### New Cement Kiln for Cuba.

IT is reported that a new kiln is to be installed at the El Morro cement works at Mariel, Cuba. The works will then have six kilns in operation ; the capacity will be 1,200 tons of cement per day.

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# Papers on Cement at the Congress of Industrial Chemistry.

THE following notes on some of the papers dealing with cement presented at the 23rd Congress of Industrial Chemistry held in Milan in September, 1950, are based on summaries published in " Revue des Materiaux de Construction."

## Reactions of the Sulphates During the Setting of Portland Cement.

Experiments on thirty-eight cements, made with industrial and laboratory clinkers, with the object of studying the reactions between the sulphates and the products resulting from the hydration of the phases containing alumina, are described by R. Bucci. A general equation expressing the speed of the reaction is derived in terms of the specific surface, the sulphate content, and the chemical composition of the clinker. The semi-hydrate form of calcium sulphate and the sulphates in the clinker react in the same manner as the gypsum and have the same effects. The increase in the speed of the reaction due to alkalis in the clinker is investigated by the analysis of solutions in contact with the cement paste. The behaviour of cement pastes made with solutions containing known quantities of hydrates, sulphates, and calcium carbonate, and the minimum sulphate content necessary to prevent rapid setting of the cement, are also considered.

## Kaolin and Zeolites.

Two papers, in which A. Rebuffat considers zeolitic action, are a continuation of papers presented by the author to the two preceding congresses and summarised in this journal for May, 1948, and January and March, 1949.

The results of an examination by X-rays of mixtures of kaolin and calcium carbonate when subjected to different conditions of burning confirm in general the author's hypotheses on the production and properties of silals (alumino-silicate substances having the properties of an oxide mixture and a complex acid). Burning the mixtures at about 900 deg. C. produces compounds that are not identifiable in mixtures of silicates and aluminates, but at 1400 deg. C. different compounds are produced. The substances produced by burning at 900 deg. C. set when mixed with water and produce particles having exceptional properties and distinctive patterns differing from those of known hydrated products. Details are given of the development of the reactions of the burned mixtures and water, which follow the laws of osmosis. Using solutions of the same concentration (that is the same number of grammes per litre) differing groups of substances are obtained, while isotonic solutions (that is solutions having the same osmotic pressure) give identical groups.

In the second paper the author shows how the utilisation of the zeolites, obtained by the reaction of water on the products obtained by burning mixtures of kaolin and calcium carbonate, enables the phenomenon of chemical exchange to be studied.

## Pozzolana Cement.

To measure the activity of pozzolana, L. Santarelli and A. Guzzini adopted the method developed by Franke which permits the determination of the oxide

and hydrate of calcium without altering the anhydrous and hydrated constituents of the cement. The method was first applied to blank determinations in order to confirm the insolubility of the products of the reaction of the calcium and pozzolana in an acetacetic alcohol-isobutylic-ether mixture. To obviate difficulties met in the tests, such as the coloration of the ether-alcoholic liquid by a high content of $Fe_2O_3$ in the cement, the free lime was proportioned gravimetrically. The results of the tests demonstrated that the method was well adapted to the study of pozzolanic activity.

### False Setting.

The false setting of artificial and blastfurnace cements is attributed by P. Lhopitallier and P. Stiglitz to the rehydration of semi-hydrated and anhydrous calcium sulphates, which themselves result from the dehydration of the gypsum under the influence of high temperature, particularly during grinding.

### Porosity of Hydrated Portland Cement.

The porous nature of hydrated Portland cement when examined under a reflection microscope is clearly visible but, according to B. Tavasci, the colloidal theory of the hydration of Portland cement gives grounds for believing that much finer pores exist. Observations at various degrees of dryness of the isotropic mass which is primarily gelatinous and which, in the form of a homogeneous band, envelops the non-hydrated alite, does not show in relief the finer variations. Theoretical considerations indicate that the size of the finer pores, although for some reason invisible under a microscope, are greater than $10^{-7}$ cm.


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